Volume 12 | Issue 9 Article 1

2015

Global warming – impacts of global climate change on the Midwest

Eugene Takle
Iowa State University, gstakle@iastate.edu

Don Hofstrand
Iowa State University, dhof@iastate.edu

$$

Ag Decision Maker

$$

A Business Newsletter for Agriculture

Vol. 12, No. 9 www.extension.iastate.edu/agdm July 2008

Global warming – impacts of global climate change on the Midwest

by Eugene Takle, Professor of Atmospheric Science and Professor of Agricultural Meteorology, 515-294-9871, gstakle@iastate.edu and Don Hofstrand, value-added agriculture specialist, co-director AgMRC, Iowa State University Extension, 641-423-0844, dhof@iastate.edu

(sixth in a series)

In previous articles we discussed the science of climate change and how agriculture is affecting it. However, in the short term (next 50 years) we can do little to mitigate the effects of climate change. Changes during this period have already been set in motion by past greenhouse gas emissions. Limiting greenhouse gas emissions in the future will only affect climate change in the long-term (beyond 50 years). So we must learn to adapt to the changes in climate that will occur over the next 50 years. In this article we discuss some of the ways that climate change may affect Midwest agriculture. A better understanding of these climate changes will help us harden agriculture to adverse changes and find new opportunities that might emerge from favorable changes.

The study of global climate change discussed briefly in previous articles is an important first step in understanding Midwest climate because the atmosphere links our region with changes going on elsewhere such as tropical sea-surface temperature changes and shrinking Northern Hemisphere ice masses. However, farmers and agribusinesses are affected by local and regional – not just global – climate change. So, what changes can we expect here in the Midwest? How confidently can we make such statements? Below is a list of changes likely to occur in the Midwest as gleaned from the most recent report of the International Panel on Climate Change 2007 4th Assessment Report and from the US Climate Change Science Program Synthesis and Assessment Report of 2008. In each case we give the level of confidence (high or medium) of the scientific consensus. In some cases we have combined more than one indicator to provide factors relevant to agriculture.

Temperature-related changes:

- Longer frost-free period (Figure 1) (high)
- Higher average winter temperatures, both daily maximum (Figure 2) and daily minimum (Figure 3) (high)

continued on page 2

Handbook updates

For those of you subscribing to the handbook, the following updates are included.

Estimated Costs of Pasture and Hay Production – A1-15 (8 pages)

Delayed and Prevented Planting Provisions – A1-57 (4 pages)

Live Cattle Basis – B2-42 (1 page)

Farmland Cash Rental Rate Survey – C2-10 (14 pages)

Please add these files to your handbook and remove the out-of-date material.

continued on page 6

Inside . . .

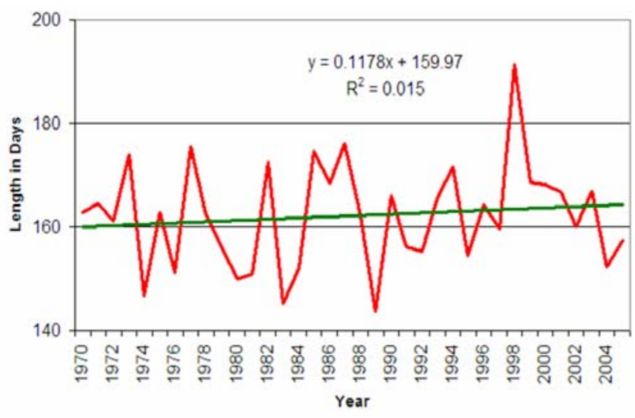
IOWA STATE UNIVERSITY
University Extension

Ag Decision Maker is compiled by:
Don Hofstrand, dhof@iastate.edu
Extension value-added specialist and
co-director of the Agricultural Marketing Resource Center

Global warming – impacts of global climate change on the Midwest, continued from page 1

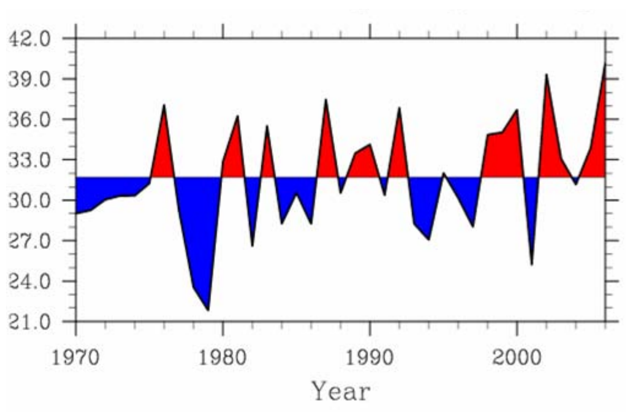
- Fewer extreme cold temperatures in winter (high)
- Fewer extreme high temperatures in summer in short term but more in long term (medium)

Figure 1. Trend in length of the frost-free season in Iowa (statewide average)



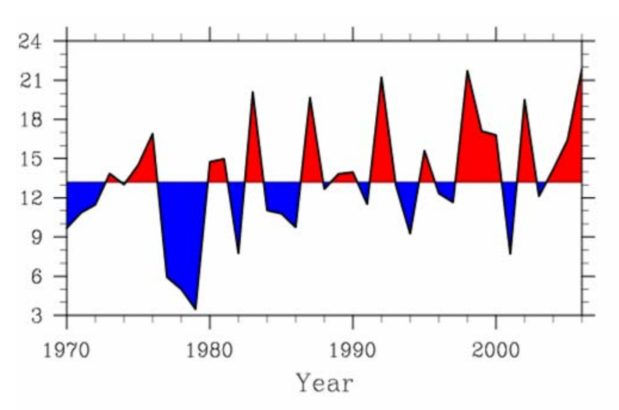
Source: D. Herzmann, Iowa Environmental Mesonet

Figure 2. Trend in average winter (Dec-Jan-Feb) daily maximum temperature (statewide average).



Source: D. Herzmann, Iowa Environmental Mesonet

Figure 3. Trend in winter (Dec-Jan-Feb) average daily minimum temperature (statewide average).



Source: D. Herzmann, Iowa Environmental Mesonet

- Higher nighttime temperatures both summer and winter (high)
- More freeze-thaw cycles (high)
- Increased temperature variability (high)

Most plant processes are accelerated under higher (except extreme) temperature. So, even though the frost-free period will be longer, the growing season required by the plant may be shortened. Nighttime temperatures have risen more than daytime temperatures over the last 30 years. This trend is likely to continue. Although it seems counter-intuitive, summer daytime maximum temperatures in Iowa have gone down in the last 30 years. We rarely have extended periods of 100+ °F temperatures. This is in part due to more precipitation and likely slightly more cloudiness.

Over-wintering of pests may be more of a problem in the future. It is already happening in the Rocky Mountains where the pine-bark beetle is expanding its range northward and to higher elevations due to fewer extreme cold events.

More freeze-thaw cycles might be better for breaking down hard-pan soils and allowing more winter recharge of soil moisture. They may be detrimental to animal health, however, and certainly will create more challenges for road maintenance.

Higher day-to-day and year-to-year variability in temperatures (2007: warm March followed by widespread freeze in early April; 2008: cold March-May) can damage agricultural and fruit crops as happened in 2007, or delay spring planting and crop growth as happened in 2008.

Precipitation-related changes:

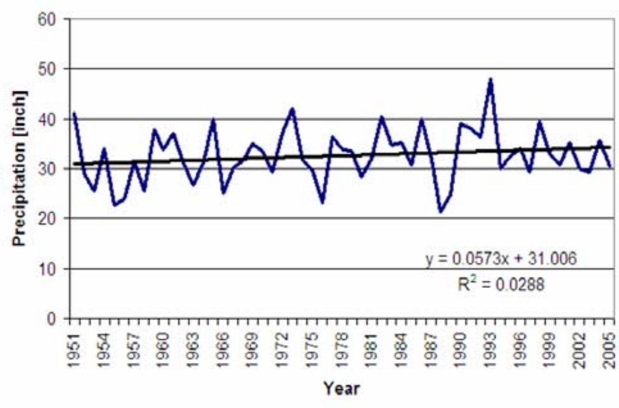
- More (~10%) precipitation annually (Figure 4) and during the growing season (Figure 5) (medium)
- Most of the increase will come in the first half of the year (wetter springs, drier or little change in summers) (high)
- More water-logging of soils (medium)
- More variability of summer precipitation (high)
  - –More intense rain events and hence more runoff (high)
  - –Higher episodic streamflow (medium)
  - –Longer periods without rain (medium)
- Higher absolute humidity (Figure 6) (high)
- Stronger storm systems (medium)
- Snowfall increases (late winter) in short term but decreases in long run (medium)
- More winter soil moisture recharge (medium)

Precipitation is much more difficult for climate models to simulate. So we have less confidence in the predictions of changes in precipitation due to climate change (more

continued on page 3

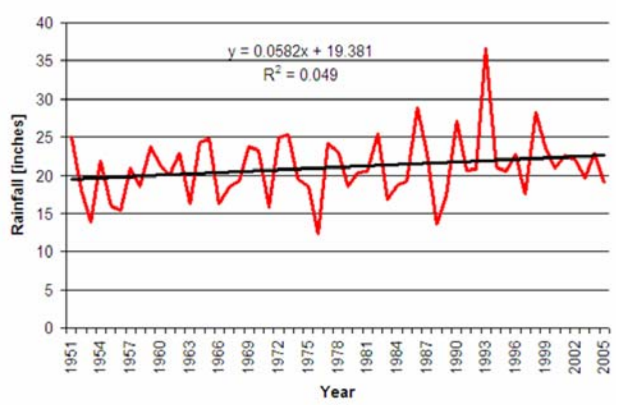
Global warming – impacts of global climate change on the Midwest, continued from page 2

Figure 4. Trend in Iowa total annual precipitation



Source: D. Herzmann, Iowa Environmental Mesonet

Figure 5. Trend in Iowa growing season precipitation.



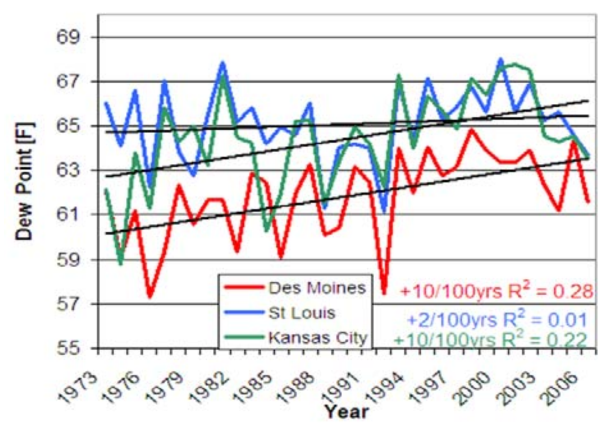
Source: D. Herzmann, Iowa Environmental Mesonet

"mediums" and fewer "highs" in the confidence levels). A complicating issue of assessing changes in precipitation in the Midwest is that we are located close to regions of high precipitation gradients. That is, annual precipitation is much less in western Iowa than eastern Iowa and less in northern Iowa than southern Iowa. In Illinois, there is less in the north than the south, but east-west differences are small. So if precipitation patterns shift eastward, for instance, in a future climate, Iowa will be more affected than Illinois, but both will be affected by a northward shift of higher rainfall.

Other changes:

- Reduced wind speeds (high)
- Reduced solar radiation (medium)
- Increased tropospheric (atmospheric layer next to the earth) ozone (high)
- Accelerated loss of soil carbon (high)
- Faster plant growth and development to maturity (high)
- Weeds and vines grow more rapidly under elevated atmospheric CO_2 (high)

Figure 6. Trends in summer (Jun-Jul-Aug) dew-point temperature at three locations in the Midwest.



Source: D. Herzmann, Iowa Environmental Mesonet

- Weeds migrate northward and are less sensitive to herbicides (high)
- Plants have increased water-use efficiency (high)
- Combinations of conditions and pathogens more favorable for development of toxins (medium)

Reduced wind speeds can affect pollination and dispersion of pests and pathogens and, of course, influence wind power generation. At ISU we are examining the impact of climate change on wind speeds.

Increased precipitation in our region likely would be accompanied by more cloudiness and hence less solar radiation, particularly in spring. This likely would slow early-season crop growth.

Higher temperatures promote conditions that allow for the generation of tropospheric (atmospheric layer next to the earth) ozone from automobile exhaust. Ozone near the ground now likely accounts for a small reduction in yield, but may rise to as much as 30% over the next century.

Higher temperatures and more soil moisture accelerate the microbial action in soil. This leads to a faster breakdown of plant materials to form carbon dioxide out of soil carbon, increasing the loss of soil carbon.

Plant biological processes also are accelerated, which may be good or bad. A shortened pollination period for corn, for instance, might increase its vulnerability to drought – even short period droughts.

Many weeds, particularly C_3 weeds [1/], respond more quickly to elevated CO_2 than crops. Herbicides are, in some cases, less effective on weeds grown under these conditions.

Crops grown under high CO_2 environments do not require stomatal (minute pores in the epidermis of a leaf or stem

continued on page 4

Global warming – impacts of global climate change on the Midwest, continued from page 3

through which gases and water vapor pass) openings as wide as those grown under lower CO_2. A positive side effect of this is that plants tend to conserve water better and thereby increase their water-use efficiency.

A plant that is stressed, by whatever cause, is more vulnerable to succumb to other biotic (living) or abiotic (non-living) stresses. For example, if humidity levels increase, corn encountering drought during the grain-filling phase may be more vulnerable to mycotoxin or aflatoxin growth. We are only beginning to understand how such combinations of stress factors interact to challenge the flourishing of agricultural crops.

In our next article we will look internationally at how climate change may affect other regions of the world where crops are grown for export.

[1/] C_3 plants show greater photosynthetic response to elevated levels of CO_2 than C_4 plants (e.g. corn).

Cash rental rates jump in 2008

by William Edwards, extension economist, 515-294-6161, wedwards@iastate.edu

As anyone who is involved with the rental market for Iowa farmland knows, rental rates have been jolted by the sharply higher corn and soybean prices that have been available for the past two years. Results from an Iowa State University Extension survey estimated that the average cash rent for corn and soybean land in the state for 2008 was $177 per acre, compared to $150 in the 2007 survey. This is the largest increase in a single year since the statewide survey was initiated in 1994. All of the 12 areas in Iowa showed increases, ranging from $18 to $32 per acre. Average estimates exceeded $200 per acre in many counties.

The intent of the ISU survey is to report typical rents in force for 2008, not the highest or lowest values heard through informal sources. Rental values were estimated by asking more than 1,000 tenants, landowners, farm managers, lenders, and other people familiar with the land market what they thought were typical rates in their county for high, medium, and low quality row crop land, as well as for hay and pasture acres. Opinions about rental rates varied widely, even within counties, indicating a great deal of uncertainty this year.

The most positive factor affecting rents has been higher grain prices, especially for corn. Consistently good yields in recent years also have lent support. On the negative side, escalating costs for fuel, fertilizer, seed, pesticides, and machinery have offset some of the higher revenues. Wet, cool weather and flooding in Iowa may dampen competition for rented land for 2009.

The latest survey also presents typical dollars of rent per bushel of corn and soybean yield for each county, based on the county average yield for each crop during the last 5 years. This year the rent per bushel ranged from $1.00 to $1.20 for corn and from $3.40 to $4.26 for soybeans across the 12 areas. The average rental rate per point of corn suitability rating (CSR) also was estimated, and ranged from $2.15 to $2.50 for most counties. These values are useful for adjusting rental rates for higher or lower than average productivity levels on individual farms.

Survey results are intended to be used as guidelines, only. The appropriate rent for an individual farm should take into account factors such as fertility levels, drainage, USDA program parameters, size and shape of fields, existence of seed production or manure application contracts, local grain prices, and other services provided by the tenant.

Other resources include Ag Decision Maker information file C2-20, Computing a Cropland Cash Rental Rate, and file C2-21, Flexible Farm Lease Agreements. Both of these include decision file electronic worksheets to help analyze leasing questions.

Farmland Leasing Workshops also are being held throughout Iowa during July and August. These workshops are designed to assist landowners, tenants, and other agri-business professionals with issues related to farmland ownership, management, and leasing agreements.

Each workshop attendee will receive a set of useful materials about farm leasing arrangements.
Workshop Content
- Cash rental rate survey
- Comparison of different types of leases
- Terminating a lease
- Affect of yields and prices
- Current farmland values
- Agricultural trends and issues
- Tenant/landowner relationship
- Internet Resources
- Use of spreadsheets to compare leases
- Opportunity for questions

Workshops will last approximately 3 hours and will be led by Iowa State University Extension farm management specialists. Meeting dates and locations are available at: www.extension.iastate.edu/agdm/info/meetings.html.